Light use efficiency (LUE) plays a vital role in determination of crop biomass and yield. Important components of LUE, i.e. canopy structure, nitrogen distribution, photosynthetic capacity and CO_2 diffusion conductance were investigated in paddy rice grown under low, normal and high supplemental nitrogen (0, 115, and 180 kg N ha^{-1}). Photosynthetic characteristics varied linearly with leaf nitrogen content (N_a), independent of treatment and canopy position, so differences in photosynthesis were due to differences in N allocation. CO_2 diffusion resistances were significant and constrained LUE (more during late season), but there were no differences between treatments. Early in the season (tillering stage) leaves in the fertilized treatments had higher photosynthetic rates due to higher leaf N content leading to larger amounts of rate-limiting photosynthetic proteins, which gave them an early head start and boost in productivity and leaf area index (LAI), bringing increases in canopy light interception. Later during the growth season, differences in leaf N_a and photosynthetic characteristics between treatments were slight. Enhanced LAI in fertilized plots throughout the growing season was related to greater leaf number and leaf area per planted bundle and a larger leaf area in the upper canopy (LAUC). Fertilized treatments had a higher LAUC with high leaf nitrogen concentration and reduced mesophyll diffusion limitation but greater exposure to full sunlight that led to improved nitrogen use efficiency and efficient carbon gain. In conclusion, differences in carbon gain and biomass accumulation under differing N fertilization were associated primarily with resource allocation associated with canopy leaf area development rather than leaf morphological or physiological properties. The results provide new insights with respect to the multidimensional coordinated structural and physiological adjustments governing LUE over the course of rice crop development.